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Title	<b>Clarification and Fixes in the MBS definitions and procedures</b>	
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Re:	P802.16Rev2/D3, LB26b	
Abstract	MBS definitions and procedures in the REV2 D2 draft need adjustments and some errors need to be fixed.	
Purpose	Adoption toward REV2/D3	
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## **Proposed Clarifications Needed to MBS in 802.16REV2**

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### **Problems with Current REV2 D3 text:**

Considering the realistic deployments and operators requirements for MBS, the MBS text in REV2D3 requires some technical corrections and clarifications as follows:

1. Multi-BS MBS should be generalized to cover semi-synchronous multi-BS multicasting.
2. Single BS MBS can be considered as special case of multi-BS MBS and its not needed
3. Text needs to be clear about the parameters which need to be the same across all BS with the same zone with macro-diversity is enabled or disabled.
4. Considering most MBS deployment involve many content channels in each MBS service, the current text more clearly specify
  - How parameters associated with multiple MBS content channels and their updates can efficiently conveyed to subscribed users at the time of service initiated and subsequent updates.
  - How to minimize signaling interaction with the network while a user in idle mode switches among content channels.
  - How to minimize signaling interaction and latency with for updating MCID's for user as they cross the MBS Zones.
  - How to allow power efficiency by selectively discarding undesired content in a multi-channel MBS burst.
5. The text also need to offer allow means of delivering MBS parameters at upper layers if supported by the network.
6. The use case and value add of LCID need to be clarified.

### **Proposed Text Changes/Updates:**

#### **6.3.2.3.52 MBS\_MAP (multicast and broadcast service map) message:**

The BS shall send an MBS\_MAP message on the Broadcast CID to specify the location and size of multi-BS MBS data bursts which are located in ~~DL-permutation-zones for MBS~~ in frames that are from 2 to 5 frames in the future from the frame containing the MBS MAP message. If present, an MBS\_MAP message shall be located in the first data region in the ~~corresponding DL-permutation-zone for MBS~~ [data region](#). ~~In terms of multi-BS MBS, a DL-permutation-zone for MBS is considered an MBS-portion.~~ The MBS\_MAP message format is presented in Table 153. This message includes the MBS\_DATA\_IE, Extended\_MBS\_DATA\_IE and MBS\_DATA\_Time\_Diversity\_IE which define the access information for the MBS burst. See Tables 153 [to 156](#).

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**MBS DIUC Change Count** It is used to notify the Burst Profile used for multi-BS MBS data has been changed. If MBS\_DIUC\_Change\_Count change, MS should wait until receiving DCD message unless Downlink Burst Profile TLV is included in MBS\_MAP message.

The following TLV may be included in MBS\_MAP message:

**Downlink Burst Profile** Downlink Burst Profile is used for the definition of MBS DIUC. The MBS DIUC overrides the DIUC in DCD message for the MBS portion of the frame. If MBS

DIUC is not defined by MBS MAP message, DIUC in DCD message shall be used instead. See Table 154, Table 155, and Table 156.

### 6.3.13 Establishment of multicast connections

The BS may establish a DL multicast and broadcast service by creating a multicast connection with each SS to be associated with the service. Any available traffic CID value may be used for the service (i.e., there are no dedicated CIDs for multicast transport connections). To ensure proper multicast operation, the CID used for the service is the same for all SSs on the same channel that participate in the connection. The SSs need not be aware that the connection is a multicast connection. However for multicast and broadcast services which utilize MBS specific features the multicast and broadcast connection shall be established by creating a multicast connection using multicast CID's with each SS to be associated with the service.

The data transmitted on the connection with the given CID shall be received and processed by the MAC of each involved SS, if selected by the user. Thus, each multicast or broadcast SDU is transmitted only once per BS channel. Since a multicast connection is associated with a service flow, it is associated with the QoS and traffic parameters for that service flow. ARQ is not applicable to multicast connections. If a DL multicast connection is to be encrypted, each SS participating in the connection shall have an additional security association (SA), allowing that connection to be encrypted using keys that are independent of those used for other encrypted transmissions between the SSs and the BS.

### 6.3.23 Multicast and broadcast service (MBS)

This section describes the operation of Multicast and Broadcast Services which refers to efficient and concurrent transport of a common data to a group of users using a common CID. This service is offered in the downlink only and may be coordinated and optionally synchronized among a group of BS's to allow macro-diversity.

MBS is defined as a kind of service that all successfully registered MS's subscribed to the specific MBS connection can receive on the cell the encrypted MAC PDUs of the multicast and broadcast content that multiple BSs transmit anywhere under the given time period. Some globally defined service flows may carry broadcast or multicast information that should be delivered to a plurality of SS or MS. Such The service flows associated with MBS have certain QoS parameters and may require encryption performed using a globally defined sequence of TEKs. Since a multicast connection is associated with a service flow, it is associated with the QoS and traffic parameters for that service flow.

~~Some MS are registered to certain BS while some are in idle mode and not currently served by any specific BS. Two types of access to MBS may be supported: single BS access and multi BS access. Single BS access is implemented over multicast connections within one BS, while multi BS access is implemented by transmitting data from service flow(s) over multiple BS. MS may support both single BS and multi BS access. ARQ is not applicable to either single BS MBS or multi BS MBS. Initiation of MBS with respect to specific MS is always performed in registered state by creation of multicast connection carrying MBS data. During such initiation the MS learns the SFID that identifies the service. For multi BS MBS, each BS capable of providing MBS belongs to a certain MBS Zone, which is a set of BSs where the same CID and same SA is used for transmitting content of certain service flow(s). MBS Zone is identified by a unique MBS\_Zone ID~~

~~**6.3.23.1 Single BS access** The BS may provide the MS with single BS access by creating a multicast traffic connection with each MS to be associated with the service connection. Any available traffic CID value may be used for the single BS MBS service. The CID used for the service is the same for all MS on the same channel that participate in the connection. The data transmitted on the connection with the given CID shall be received and processed by the MAC of each involved MS. Thus, each multicast MAC SDU is transmitted only once per BS channel. If a DL multicast connection is to be encrypted, each MS participating in the connection shall have an additional security association (SA), allowing that connection~~

~~to be encrypted using certain keys that are independent of those used for other encrypted transmissions between the MS and BS.~~

### ~~6.3.23.2 Multi-BS access~~

~~Multi-BS MBS is defined as a kind of service that all MSs successfully registered to the specific multi-BS MBS connection (each MS needs register to MBS service at the network level simultaneously) can receive on the cell the encrypted MAC PDUs of the multicast and broadcast content that multiple BSs transmit anywhere under the given time period. It requires the multiple BS participating in same multi-BS MBS service to be synchronized in the transmissions of common multicast/broadcast data. To ensure proper multicast operation on networks of BS employing synchronized transmissions of common multicast data, the CID used for a multi-BS MBS connection shall be the same for all BS and MSs on the same channel that participate in the connection. Multicast service synchronized across multiple BS enables an MS to receive the multicast or broadcast transmission from multiple BS, and thereby improve the reliability of reception. In contrast to single BS access, multi-BS access does not require that the MS be registered to the BS from which it receives the transmission, or to any other BS. In this case, transmitted MAC PDUs shall use the same CID, and transport the same data synchronized across the group of BS across the group of BS. A multicast and broadcast zone ID (MBS\_Zone) is used to indicate the group of BS through which a CID and SA for a broadcast and multicast service flow are valid.~~

~~During a Dynamic Service Addition procedure, an MBS connection for multiple MBS contents can be established by using an MBS Contents Identifier TLV encoding in DSA-REQ or DSA-RSP message sent by the BS as described in 11.13.36. In other words, when the MS sends DSA-REQ message with the MBS service request as described in 11.13.23, the BS may respond to it with DSA-RSP message including an MBS Contents Identifier TLV encoding. The BS may also send the MS a DSA-REQ message including an MBS Contents Identifier TLV encoding in order to make an establishment of an MBS connection. Logical Channel ID, which pairs with Multicast CID in the Extended MBS DATA IE, is allocated to each MBS Contents IDs in the order that it is included in TLV value. As a result, an MS can receive multiple MBS messages for an MBS connection with different MBS contents distinguished by Logical Channel ID belonging to a Multicast CID. BS shall allocate MBS PDUs in the order that the combination of Multicast CID and Logical Channel ID is defined in Extended MBS DATA IE.~~

Initiation of MBS with respect to specific MS is always performed in registered state by creation of multicast connection carrying MBS data. During such initiation the MS learns the parameters that identify the service and associated service flows. When MBS is deployed each BS capable of providing MBS belongs to a certain MBS Zone, which is a set of BS's where the same CID and same SA is used for transmitting content of certain service flow(s). Each MBS Zone is identified by a unique MBS\_Zone ID. To ensure proper multicast operation on networks of BS employing MBS the CID's used for a common MBS content and service shall be the same for all BS within the same MBS-Zone. This would help the MS who has already registered with service to be seamlessly synchronized with MBS transmissions within an MBS\_Zone with out interacting or re-registering with other BS's within that MBS-Zone. The MBS\_Zone ID's shall not be reused across any two adjacent MBS zones, unless all the key MBS burst attributes including the content, MCID and service flow encodings are the same between them.

ARQ and HARQ are not applicable to multicast connections as there is no feedback from the MS/SS at later 1 or layer 2. However MBS may be used with time-diversity enabled allowing a HARQ like behavior, where some of HARQ parameters are used for MBS burst to allow proper sequencing and time diversity combining when MBS burst are retransmitted, without requiring any layer 1 or layer 2 acknowledgements from the SS/MS.

Logical Channel ID, which pairs with Multicast CID in the Extended MBS DATA IE, is allocated to each MBS Contents IDs in the order that it is included in TLV value. As a result, an MS can receive multiple MBS messages for an MBS connection with different MBS contents distinguished by Logical Channel ID belonging to a Multicast CID. BS shall allocate MBS PDUs in the order that the combination of Multicast CID and Logical Channel ID is defined in Extended MBS DATA IE.

If a DL multicast connection is to be encrypted, each SS participating in the connection shall have an additional security association (SA), allowing that connection to be encrypted using keys that are independent of those used for other encrypted transmissions between the SSs and the BS.

Multicast and broadcast service flows may be encrypted at the application layer or MAC or both. Upper layer encryption may be employed to prevent non-authorized access to multicast and broadcast content. MBS may provide access control against theft of service by enforcing data encryption based on advanced encryption standard with counter mode encryption (AES-CTR) defined in NIST Special Publication 800-38A and FIPS 197. Details of MBS security is defined in 7.8.3.

For all BSs that belong to the same MBS Zone and using the same MBS Zone ID.:

- Mapping of SDUs into the MBS Bursts should be identical, and same SDU's shall be transmitted in the same frame in all the BS in the same MBS Zone.
- SDUs shall be identically mapped into MAC PDUs, which means that the order of the SDUs within the MAC PDUs must be identical, the Generic MAC Headers and MAC Subheaders used must be identical, fragmentation and/or packing must be identical, fragmentation sequence numbering (FSN) must be identical.

This allows the user to continue receiving MBS data within a zone if it is in idle mode or not registered to the BS from which it receives the transmission.

MBS transmissions may optionally be synchronized across all BS's within an MBS Zone to enable macro-diversity. This option enables an MS to receive the multicast or broadcast transmission from multiple BS using macro-diversity, and thereby improve the reliability of reception. When Macro-diversity is enabled additional parameter may also be required to be the same across BS's if macro-diversity is used, see section 6.3.23.2

A BS may provide the MS with MBS content locally within its coverage and independently of other BS's. The single-BS access to MBS is therefore a configuration where MBS Zone is configured to consist of one BS only. This configuration may be provided as one of the possible cases of multi-BS MBS. In this case any multicast CID value may be used for the BS providing the MBS service independent of other BS's. For the case of single-BS access to MBS the MS receives the MBS data from the same BS to which the MS has registered for MBS and the service flow for this MBS connection may not continue over neighboring BS's.

~~It requires the multiple BS participating in same multi-BS MBS service to be synchronized in the transmissions of common multicast/broadcast data. To ensure proper multicast operation on networks of BS employing synchronized transmissions of common multicast data, the CID used for a multi-BS MBS connection shall be the same for all BS and MSs on the same channel that participate in the connection. Multicast service synchronized across multiple BS enables an MS to receive the multicast or broadcast transmission from multiple BS, and thereby improve the reliability of reception. In contrast to single BS access, multi-BS access does not require that the MS be registered to the BS from which it receives the transmission, or to any other BS. In this case, transmitted MAC PDUs shall use the same CID, and transport the same data synchronized across the group of BS across the group of BS. A multicast and broadcast zone ID (MBS\_Zone) is used to indicate the group of BS through which a CID and SA for a broadcast and multicast service flow are valid. During a Dynamic Service Addition procedure, an MBS connection for multiple MBS contents can be established by using an MBS Contents Identifier TLV encoding in DSA\_REQ or DSA\_RSP message sent by the BS as described in 11.13.36. In other words, when the MS sends DSA\_REQ message with the MBS service request as described in 11.13.23, the BS may respond to it with DSA\_RSP message including an MBS Contents Identifier TLV encoding. The BS may also send the MS a DSA\_REQ message including an MBS Contents Identifier TLV encoding in order to make an establishment of an MBS connection. Logical Channel ID, which pairs with Multicast CID in the Extended MBS\_DATA IE, is allocated to each MBS Contents IDs in the order that it is included in TLV~~

~~value. As a result, an MS can receive multiple MBS messages for an MBS connection with different MBS contents distinguished by Logical Channel ID belonging to a Multicast CID. BS shall allocate MBS PDUs in the order that the combination of Multicast CID and Logical Channel ID is defined in Extended MBS DATA IE.~~

### 6.3.23.1 Establishment and maintenance of MBSs

Establishment of MBSs with respect to certain service flow is always performed when MS is registered to certain BS. ~~Such establishment is specified in 6.3.23.1.~~ MBSs are associated with multicast and broadcast service flows. Multicast and broadcast service flows are not dedicated to the specific MS and are maintained even though the MS is either in awake/sleep mode or in the idle mode. When an MS is registered at a BS for receiving MBS, multicast and broadcast service flows shall be instantiated as multicast connections. Data of multicast and broadcast service flows may be transmitted from BS and received at MS also regardless of what mode the MS is currently in. The BS may establish a DL MBS by creating a multicast and broadcast service flows when the service commences. Mapping of multicast and broadcast SFIDs to CIDs shall be known to all BSs belong to the same MBS zone.

When the MS registers at the BS for receiving multicast and broadcast services, the BS or MS may initiate the DSA procedure with respect to multicast and broadcast connections. Such knowledge may be used to initiate bi-directional upper layers communication between the MS and the network for the purpose of configuration of multicast/broadcast service. After the successful configuration, the MS shall reuse the same configuration when it moves to another BS without re-configuration.

The configuration of multicast/broadcast service may also be done by upper layer communication only, without DSA procedure. In this case, the communication between the MS and the network includes MBS content information – i.e., a service guide for MBS service, and is outside the scope of this specification.

During communication to the BS the MS may learn MBS\_Zone ID. If MS acquired MBS\_Zone and goes to idle mode, then the MS may continue receiving MBS content from any BS that advertises the same MBS\_Zone. By doing this, the MS uses the same CID's and SA's that were used in registered state. In case MS, still in Idle state, migrates to BS advertising another MBS\_Zone, it is expected to register at that BS and to acquire a new CID and SA for further reception of MBS content unless such information is provided to the user in one of BS's in the serving MBS-Zone.

During a Dynamic Service Addition procedure, an MBS connection for multiple MBS contents can be established by using an MBS Contents Identifier TLV encoding in DSA-REQ or DSA-RSP message sent by the BS as described in 11.13.36. In other words, when the MS sends DSA-REQ message with the MBS service request as described in 11.13.23, the BS may respond to it with DSA-RSP message including an MBS Contents Identifier TLV encoding. The BS may also send the MS a DSA-REQ message including an MBS Contents Identifier TLV encoding in order to make an establishment of an MBS connection.

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~~Multicast and broadcast service flows are encrypted at the application layer or MAC or both. Upper layer encryption may be employed to prevent nonauthorized access to multicast and broadcast content. MBS may provide access control against theft of service by enforcing data encryption based on advanced encryption standard with counter mode encryption (AES-CTR) defined in NIST Special Publication 800-38A and FIPS-197. Details of MBS security is defined in 7.8.3.~~

### 6.3.23.2 Performance enhancement with macro diversity

~~To increase the receiving performance, MBS transmission in a group of BS should be synchronized. In such case, each BS shall transmit the same PDUs, using the same transmission mechanism (symbol, subchannel, modulation, and etc.) at the same time.~~

Multiple BS's participating in same multi-BS-MBS service MAY be time and frequency synchronized in the transmissions of common multicast/broadcast data to allow macrodiversity gain at the MS.

When macro-diversity is enabled the MBS bursts positions and dimensions as well as PHY parameters shall be the same across all BS's within the same MBS Zone.

These parameters include:

- DUIC parameters associated with each MBS Burst including FEC Type, Modulation Type, Repetition Coding
- Mapping of SDUs to PDU (order of the SDUs and fragments) including Sub Headers
- Mapping of PDUs to bursts
- Order of bursts in the zone/region
- MAP construction

The way that multiple BSs accomplish the synchronized transmission (which implies performing functions like classification, fragmentation, scheduling at a centralized point called the MBS Server) is outside the scope of the standard.

**6.3.23.3 Power saving operation** To facilitate power efficient reception of MBS data, an MBS MAP IE may be placed in the DL-MAP to point to the location of a dedicated MBS [region](#) allocation in the DL subframe. The purpose of this IE is to do the initial direction of the MS to the MBS allocation, and to redirect MS that [has](#) lost synchronization with MBS allocations back to the next MBS allocation.

### 6.3.23.4 Multicast and broadcast zone (MBS\_Zone)

Different CIDs or different SAs may be used in different [service areas](#) [regions](#) for the same multicast and broadcast service flow. A multicast and broadcast zone identifier (MBS\_ZONE) is used to indicate a [service area](#) [region](#) through which a CID and SA for a broadcast and multicast service flow are valid. A BS that supports Multi-BS Access MBS shall advertise MBS\_ZONE in DCD message. In case BS sends DSA for establishment of connection for MBS, MBS\_ZONE shall be encoded in the DSA message. If an MS in Idle mode moves into BSs in the same MBS zone, the MS does not have to re-enter the network and to re-establish a connection or a connection defined by MBS Contents Identifier to monitor the multicast and broadcast service flow. However, if an MS moves into a different MBS zone, the MS may need to re-establish a connection or a virtual connection for the multicast and broadcast service flow. One BS may have multiple MBS zone IDs [for different MBS services](#).

**8.4.5.3.12 MBS MAP IE** In the DL-MAP, a BS may transmit DIUC = 14 with the MBS\_MAP\_IE() to indicate when the next data for a multicast and broadcast service flow will be transmitted.

**Macro diversity enhanced** Indicates [if macro-diversity is used](#) ~~type of MS for~~ access to MBS. If this value is 1, the type of access is Multi-BS Access [with Macro-Diversity](#). If this value is 0, [it indicates that Macro-diversity is not used.](#) ~~the type of access is Single-BS Access~~

**Next MBS\_MAP\_IE Frame Offset** The Next MBS\_MAP\_IE Frame Offset value is lower 8 bits of the frame number in which the BS shall transmit the next MBS MAP IE frame.

~~For the case of multi-BS MBS, an~~ **The** MBS MAP message shall be located at the first subchannel and first OFDMA symbol of the [MBS region](#) reserved for MBS [data](#) that is specified by the MBS MAP IE when 'Macro diversity enhanced' is set to 1. This [MBS Region](#) ~~DL-permutation-zone for~~ ~~MBS~~ shall be located in the same frame as the MBS MAP IE that specifies it. The location of this

MBS Region DL permutation zone for MBS within the frame is specified by 'OFDMA Symbol Offset' in MBS MAP IE ~~when 'Macro diversity enhanced' is set to 1.~~

**11.13.23 MBS service TLV**

This TLV indicates whether the MBS service is being requested for the connection that is being setup. A value of 1 indicates ~~Single BS MBS~~ that an MBS service limited to serving BS is being requested and a value of 2 indicates a multi-BS-MBS is being requested. If MS or BS wants to initiate MBS service, DSA-REQ with MBS service TLV may ~~shall~~ be used. The DSA-RSP message shall contain the acceptance or rejection of request and if there is no available MBS, MBS service value ~~shall~~ may be set to 0. ARQ shall not be enabled for this connection.

Type	Length	Value	Scope
[145/146].4	1	0: No available MBS 1: <del>Single BS MBS</del> <u>MBS in Serving BS Only</u> 2: <del>Multi BS MBS</del> <u>MBS in a multi-BS Zone</u>	DSA-REQ DSA-RSP DSA-ACK